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Biological Sciences review

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Volume 35, Number 1, September 2022

Activity

The trouble with tropical soils

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Introduction

Use information from Jonny Miller's article, 'The trouble with tropical soils', and your own knowledge to answer the following questions.

Questions

1 Explain why the undergrowth of a tropical rainforest is dominated by 'shade-loving plants'. Use the term 'compete' in your answer. [2 marks]

2 'The vegetation of an ecosystem collectively converts sunlight energy into chemical energy.'

Describe how the light-dependent reaction of photosynthesis achieves this. [6 marks]

3 (a) Explain the difference between gross primary production and gross primary productivity. [1 mark]

(b) Use information from the article to calculate the average annual production of tropical rainforests.

Give your answer in standard form. [2 marks]

4 What is meant by the 'abiotic characteristics of tropical rainforests'? [1 mark]

5 'To be bioavailable, nutrients must be soluble in water, so that plant roots can absorb them.'

Describe how plant roots absorb inorganic ions. [3 marks]

6 Give two advantages and one disadvantage of the 'slash and burn' agriculture technique. [3 marks]

7 Figure 2 of the article shows the results of an investigation into the effects of different concentrations of aluminium ions on root growth.

Outline the steps you would follow to conduct such an investigation, ensuring that your results would be reliable. [5 marks]

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Model answers

1 The plants compete for light.

The shade-tolerant plants grow better than the others in shaded conditions.

2 Any six from the following mark points:

- Absorption of light causes release of electrons from chlorophyll (molecules) / causes photoionisation of chlorophyll (molecules).
- (These chlorophyll molecules are) in photosystem II.
- These electrons are passed down an electron transfer chain / are passed down a chain of electron carriers.
- (Electron carriers are) in the thylakoid membranes (of chloroplasts).
- Electron transfer results in release of energy.
- (This energy is) used by carrier proteins in thylakoid membranes to actively transport H^+ ions into the thylakoid space.
- This creates a H^+ ion concentration gradient across the thylakoid membranes.
- Hydrogen ions diffuse from the thylakoid space to the stroma through ATPase molecules.
- The energy from this diffusion is used to form ATP from ADP and inorganic phosphate/Pi.

3 (a) Gross primary production is a measure of the chemical energy within the producers, whereas productivity is the rate of gross primary production.

(b) Answer for two marks = 1.56(024) x 10^{10} tonne

If answer incorrect, one mark for evidence of:

7,092,000 **and** 2200

OR

7.092 x 10^6 **and** 2.2 x 10^3

4 The non-living components of the ecosystem.

5 By active transport.

Each (type of) ion by a specific (type of) carrier protein.

In surface membranes (of epidermal cells) of root hairs.

6 Any two advantages from the following:

- Only a small area of land is used so little damage to ecosystem.
- Left after a short period of time so can quickly recover.
- Ash (from burning) contains minerals and neutralises soil acidity.

Disadvantage:

- Only supports a small (human) population.

7 1 mark for the below required answer:

- Produce a dilution series of aluminium hydroxide solution.

Any four from the following mark points:

- Set up containers with same mass of soil/growth medium.
- Mark containers to identify which (dilution of) solution will be added to them.
- Sow same number of seeds ≥ 10 in each sample of soil/each growth medium.
- Add same volume of appropriate diluted solution to each container.
- After specified time under identical conditions, wash seedlings of soil/growth medium.
- Measure length of longest root / measure mass of roots.
- Compare mean length/mass of roots from each container.